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DISPLAY DEVICE

Field of the Invention

This invention relates to display devices of the kind that include an edge-lit light-transmitting sheet having first and second opposed parallel surfaces.

Such a display device is hereinafter referred to as "a display device of the kind specified". It is to be understood that the term "display device" includes an illuminated sign, such as is used for advertising and promotional purposes.

One form of display device of the kind specified is described in European Patent Specification No. 0 549 679, which relates to a display device in which the first and second surfaces each have a matrix of etched, painted or screen-printed dots substantially covering said surfaces.

Another form of display device of the kind specified is described in PCT Specification No. WO 00/58931, which relates to a display device in which at least one of the first and second surfaces has a matrix of spots each having a hollow transparent interior substantially covering at least a major portion of the surface to be illuminated.

With display devices of the kind specified it is important that the presented surfaces of the device are illuminated substantially equally and, in particular, that the degree of illumination should not fall significantly at positions spaced from the source(s) of illumination.

It is accordingly an object of the present invention to provide an improved method of making a display device of the kind specified.

A further object of the present invention is to provide an improved form of display device of the kind specified.

Summary of the Invention

According to a first aspect of the present invention there is provided a method of making a display device of the kind specified which includes applying a matrix to at least one of the first and second surfaces which comprises a series of lines extending between opposed edges of the sheet and in which the spacings between the lines and/or the thicknesses of the lines are so chosen as to obtain a desired intensity of illumination at selected areas of the sheet.

According to a second aspect of the present invention there is provided a display device of the kind specified which includes a matrix applied to at least one of the first and second surfaces which comprises a series of lines extending between opposed

edges of the sheet and in which the spacings between the lines and/or the thicknesses of the lines are so chosen as to obtain a desired intensity of illumination at selected areas of the sheet.

A matrix of markings is preferably applied to each of the first and second surfaces so as to cover at least a major proportion of each surface.

The sheet of light-transmitting material is preferably of generally rectangular form and there is preferably a first series of lines extending between two of the opposed edges of the sheet and a second series of lines extending between the other two opposed edges of the sheet.

The two series of lines intersect to define a plurality of polygons, which may be squares or rectangles, but are preferably hexagons, i.e. the matrix is in the form of a honeycomb pattern.

Thus, according to a further aspect of the present invention there is provided a display device of the kind specified which includes a matrix applied to at least one of the first and second surfaces and in which the matrix is of honeycomb form.

The light-transmitting sheet may be of an acrylic material, but other transparent materials, such as glass, may be employed. One other possible material is PETG, i.e. glycol-modified polyethylene terephthallate.

The preferred method of applying the markings is by inkjet printing. This produces a substantial reduction in respect of the quality control problems that have previously been encountered when making display devices of the kind specified.

The markings may, however, be applied by means of a stencil, by means of a transfer, by laser printing or by engraving. Whichever means of applying the markings is chosen, a computer-controlled system may be used for choosing the thicknesses of the lines forming the hexagons and/or the sizes of the hexagons.

Brief Description of the Drawings

Figure 1 of the drawings shows a hexagon pattern forming part of the surface of an illuminated sign,

Figure 2 of the drawings shows another hexagon pattern,

Figure 3 of the drawings is a graph comparing the degree of illumination of an illuminated sign having markings as shown in Figure 1 with the degree of illumination of a known form of illuminated sign as referred to in the introduction to this specification,

Figure 4 shows levels of illumination obtained with fluorescent laps placed against both ends of a rectangular sheet of acrylic resin to both sides of which a matrix has been applied, and

Figure 5 shows levels of illumination obtained using different light sources.

Description of the Preferred Embodiments

Figure 1 shows the matrix in accordance with the present invention that is applied to both sides of a rectangular sheet of clear acrylic resin. The matrix of Figure 1 comprises a plurality of hexagons each of which has a maximum dimension of 4 mm. The thicknesses of the sides of the hexagons vary from one end of the matrix to the other, with the thickness increasing with increased distance from the light source. As viewed in Figure 1, the light source will be at the top of the sheet and the thicknesses of the sides of the hexagons vary logarithmically from 0.3pt to 1.77pt.

If the illuminated sign or display device has light sources at both ends, then the thicknesses of the sides of the hexagons will increase from both ends of the rectangular sheet and will have maximum values at the centre of the sheet.

In addition to, or instead of, using hexagons that have sides of increasing thickness with increasing distance from the light source, it is possible to reduce the sizes of the hexagons with increasing distance from the light source.

The matrix of Figure 2 comprises a plurality of hexagons each of which has a maximum dimension of 3 mm. The thicknesses of the sides of the hexagons vary from one end of the matrix to the other, with the thickness increasing with increased

distance from the light source. As viewed in Figure 2, the light source will be at the top of the sheet and the thicknesses of the sides of the hexagons vary logarithmically from 0.3pt to 1.9pt.

Although the preferred matrix configuration comprises a plurality of hexagons, other configurations may be used, for example, squares, rectangles, diamond shapes, octagons and the like.

It is to be appreciated that, if increased illumination is required in a particular area of a sign, for example, to high-light a specific part of an advertisement, the sides of the hexagons in that particular part of the matrix will be of increased thickness.

Figure 3 gives comparative figures for results obtained with:-

a) a display device or sign in accordance with the present invention and having an applied matrix as shown in Figure 1, and

b) a sign produced as described in European Patent Specification No. 0 549 679.

Each sign included an acrylic sheet having a thickness of 10 mm. and the upper line on the chart is that for the sign of the present invention.

As will be seen from Figure 3, the degree of illumination obtained with the sign in accordance with the present invention is consistently superior to that obtained using a sign in accordance with European Patent Specification No. 0 549 679.

The markings can be applied to the light-transmitting sheet in any convenient way and may be in the form of a transfer that is bonded to the sheet. They may also be applied by, for example, inkjet printing and laser printing.

Figure 4 shows levels of illumination obtained with fluorescent lamps placed against both ends of a rectangular sheet of acrylic resin and with a matrix of hexagons as shown in Figure 1 extending from each end of the sheet, i.e. the sides of the hexagons are of maximum thickness at the centre of the sheet.

In the particular example used to obtain the results shown in Figure 4, the hexagons had maximum dimensions of 3.5 mm. Distances are measured from the centre of the sheet.

Figure 5 shows levels of illumination obtained using different light sources, i.e. a 250w fibre optic light source, a 150w fibre optic light source and a T5 fluorescent light source, each from one end of a rectangular sheet of acrylic resin having a length of 3 metres and with a matrix of hexagons having a maximum dimension of 4 mm. The rise in light output adjacent each of the fibre optic light sources is caused by the cones of light emitted by the fibre optic tails.

As will be seen, for a sign of this size illuminated from one end, optimum results were obtained using a 250w fibre optic light source.